

**National Institutes of Health**

**Anesthetic Gases Surveillance Protocol**

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Technical Assistance Branch  
Division of Occupational Health & Safety

# ANESTHETIC GASES SURVEILLANCE PROTOCOL

## PURPOSE

This protocol establishes procedures for evaluating the potential exposure of NIH workers to anesthetic gases in the workplace.

## INTRODUCTION

An anesthetic gases surveillance program has been established at the NIH to:

- 1) Identify and quantify exposure levels of workers potentially exposed to the various anesthetic gases used at the NIH, and
- 2) Provide information on the effectiveness of the controls that are being used to minimize exposures.

In addition, these surveys provide documentation of surveillance activities to the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and the American Association for Accreditation of Laboratory Animal Care (AAALAC). The surveys for anesthetic gases will be conducted every two years.

The harmful effects to personnel from excessive exposure to anesthetic gases have been documented in various literatures. Scientific evidence obtained from human and animal studies suggest that chronic exposure to anesthetic gases increases the risk of spontaneous abortions and congenital abnormalities in the offspring of female workers and wives of male workers. Risks of hepatic and renal diseases are also increased among exposed personnel. In light of these findings, the evaluation of the potential exposure of operating room staff and support personnel to anesthetic gases continues to be a component of the Division of Occupational Health and Safety (DOHS) environmental surveillance activities.

## CRITERIA

For evaluating employee exposures to waste anesthetic gases, the NIH uses a modification of the 1977 National Institute of Occupational Safety and Health (NIOSH) criteria. These criteria recommend the following time-weighted-average (TWA) exposure limits as measured over the period of anesthesia administration:

- a) Halogenated anesthetics - 2 ppm when used alone, and 0.5 ppm when used in combination with nitrous oxide;
- b) Nitrous oxide - 25 ppm.

There are no Occupational Safety and Health Administration (OSHA) permissible exposure limits (PEL) governing exposures to either halogenated anesthetics or nitrous oxide. The American Conference of Governmental Industrial Hygienists

(ACGIH) has established Threshold Limit Values (TLV) of 50 ppm, measured as an 8-hour TWA for both the halogenated anesthetic "halothane" and nitrous oxide. There are no TLV's established for other halogenated anesthetics such as isoflurane or sevoflurane.

## ANALYTICAL METHOD

### Procedures at Least 2-Hrs in Duration

Passive dosimeters for nitrous oxide (identified by Project Officer) and passive dosimeters for halogenated anesthetic gases (3M 3500) will be used to collect personal and area TWA samples.

### Procedures Less Than 2-Hrs in Duration

For procedures lasting less than 2-hrs—but greater than 24-minutes—monitoring for employee exposures will be done using OSHA Method 103. This protocol is appropriate for enflurane, halothane, and isoflurane. OSHA 103 is not validated for sevoflurane.

### Leak Testing

The Miran Infrared Analyzer Model 1A, 18, or 182 will be used for leak testing of the anesthetic breathing circuit (machine, scavaging device, tubing, etc.). The Miran will be calibrated for nitrous oxide and the most commonly used halogenated anesthetics (e.g., isoflurane).

## MONITORING PROCEDURE

### Scheduling

Surveys of each anesthetic breathing circuit (machine, scavaging device, tubing, etc.) will be performed every two years through the appropriate supervisor or contact person. Monitoring for anesthetic gases has been changed from a one year cycle to a two year cycle due to consistently low employee exposure to anesthetic gases in the past.

If monitoring indicates exposures exceeding the criteria or excessive leaks from the anesthetic breathing circuit, a second survey will be performed once corrective actions have been implemented. The second survey should verify that the corrective actions have been properly implemented.

### Locations of Monitoring

Separate surveys will be conducted for each anesthetic breathing circuit.

The Clinical Center operating rooms will be monitored in the first phase of the 2-year survey cycle. It shall be the responsibility of the Clinical Center Safety

Office and/or Safety Committee to provide DOHS with any additions to the listing of anesthetic gas usage areas within the Clinical Center.

Animal surgery locations in Buildings 14, 28, and the NIH Animal Center—and any other areas identified as using anesthetic gases—will be monitored in the second phase. Additional anesthesia gas locations will be identified by the IC Occupational Safety and Health Specialists.

### Monitoring/Field Sampling

A survey will consist of employee exposure monitoring and leak testing of the anesthetic breathing circuit. Personal and area samples will be taken during the survey—the sampling method is dependent on the length of the procedure.

At least two personal samples and two area samples will be taken for each survey. One area sample will be taken near the anesthesia machine and the other as close as possible to the surgical team's breathing zone. The two personal samples will be collected on the two employees who have the greatest potential for exposure. In the Clinical Center surgeries, monitored personnel will normally be the anesthesiologist/nurse-anesthetist and surgeon/scrub nurse. Prior to or at the conclusion of the surgical procedure the anesthetic breathing circuit will be scanned for leaks using the Miran Infrared Analyzer.

The survey is designed to assess an employee's total exposure over the period of anesthesia administration.

A sketch of the room layout will be made, showing the locations where samples are taken. The directional air flow of the operating rooms with respect to the corridors will also be determined and recorded.

Passive dosimeters will be stored in a cool place away from chemical contaminants until used. After use, the dosimeters will be stored and analyzed as per manufacturer's instructions.

### REPORTS

Within twenty (20) working days of the completion of the fieldwork for a particular survey, the industrial hygiene contractor will prepare and submit a final report to DOHS. The final report will be delivered to DOHS through email. A hard copy will also be delivered. Copies of the final reports will be forwarded by the DOHS to the appropriate parties. The industrial hygiene contractor will indicate the names of the appropriate contacts on the report, including the supervisor responsible for the operation of the anesthetic breathing circuit.

Leaks and other problems identified by personal monitoring, direct readings and other observations that require *immediate* attention will be *promptly* reported by

the industrial hygiene contractor to the supervisor responsible for the operation of the anesthetic breathing circuit—in order to implement corrective action. In the Clinical Center, the Chief of the Division of Anesthesiology/Surgical Services and also the Clinical Center Safety Office will be notified. In other areas, the findings will be brought to the attention of the facility supervisor/contact.

In the event that personal monitoring of NIH employees demonstrates exposures exceeding the criteria, those employees will be notified, in writing, of the results of the monitoring within twenty (20) working days of the results being received from the analytical laboratory. The written notification will also outline procedures or changes being instituted to correct the overexposure.

It is the responsibility of the supervisor/contact in each location to initiate and follow-up implementation of the recommendations made in the final report. Where facility changes are needed, the IC Occupational Safety and Health Specialists will provide consultation and will monitor the progress of the project to completion. In the Clinical Center, the implementation of recommendations shall be coordinated by the Chief of the Division of Anesthesiology/Surgical Services, with the Clinical Center Safety Office providing consultation and monitoring of progress.

## REFERENCES

1. Criteria for a Recommended Standard, Occupational Exposure to Waste Anesthetic Gases and Vapors; HEW-NIOSH, 77-140. 1977.
2. Waste Anesthetic Gases in Operating Room Air, American Society for Anesthesiologists; John Lecky, M.D.; Ed. 1980.
3. Development and Evaluation of Methods for the Elimination of Waste Anesthetic Gases and Vapors in Hospitals; HEW-NIOSH, 75-137.1975.
4. Evaluation of a Passive Dosimeter for Collection of 2-Bromo-2-chloro-1,1,1-trifluoroethane and 2-Chloro-1,1,2-trifluoro-difluoromethyl ether in Hospital Operating Rooms; Mazur, J.F.et.al.; AIHA J 41-317 to 321, May, 1980.